

Armaments for the Army of the Future

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The U.S. Army
Soldier Systems Command





- Historical Soldier Load Data
- Load Carriage Research
- Representative Current Soldier Load
- Representative Land Warrior Load
- Soldier Modernization Strategy
 - Future Warrior Architecture Effort
 - Lightweight Soldier for Army After Next (AAN) Science & Technology Objective (STO)



Throughout History, Load Variations Reflect -

- **Conflict Between Equip. for a Wide Variety of Threats vs. Tactical Mobility**

- **Technological Changes Altered Nature of Warfare**
 - **Middle Ages - Armored Cavalry Displaced Infantry**
 - **Arrows Penetrate Armor Lead to Resurgence of Light Infantry**
 - **Firearms Introduction Countered by 50 lb. Protective Shields - Shields Disappeared As Firearms Became More Penetrating (late 17th century)**



Loads Carried Documented In Literature*

- Crimean War - British, French Estimated 63-73 lbs.
- British WWI - 66 lbs.
- U.S. Forces North Africa - 132 lbs.
- U.S. Forces Vietnam - 74 lbs.
- Falklands Campaign - 118 lbs.
- Grenada - 120+ lbs.
- Joint Readiness Training Center - average loads 88 lbs.
(Knapik, et. al., 1990)

* US Army Research Institute of Environmental Medicine, T19-89: Distinction not made between combat, approach, and/or sustainment



What Causes Soldiers to Enter Battle Overloaded?

- **Three False Beliefs*:**
 1. Overloading With Ammunition Is Good for Battle Morale
 - High Price Paid in Mobility, Heat Casualties
 2. Ammunition Shortages Cause Tactical Disarrangements
 - Defeat Due to Ammunition Shortages Least Likely to Happen
 - Grenada: Excessive Loads Caused Difficulty in Maintaining Contact
 3. Soldiers Should Be Prepared for Every Possible Contingency
- **Beliefs = Effects of More Basic Cause: *Battle Is a Realm of Danger and Uncertainty***
 - Mission, Enemy, Troops, Terrain/Weather, Time (METT-T) vs. Leader/Soldier Willingness to Assume Risk

* Marshall, 1950



Examples of Recommended Soldier Loads From the Literature

- Cathcart, et. al. 1923 - Energy Cost Per Unit Weight Lowest @ 40% Body Weight
- Marshall, 1950 - Optimal Training Load = 33% Body Weight, Optimal Fighting Load = 80% of Training Load
- U.S. Army Infantry Combat Developments Agency, 1964
 - 30% Body Weight for Conditioned Fighting Soldier
 - 45% Body Weight Soldier on the March
- Natick Studies, 1966
 - 30% Body Weight for Conditioned Fighting Soldier
 - 45% Body Weight Maximum Load
- FM 21-18, Foot Marches, 1990
 - Fighting Load Not Exceed 48 Pounds
 - Approach March Load (Includes the Fighting Load) Less Than 72 Pounds



1995 U.S. Army Anthropometric Survey Data:

- **Average Weight Male: 174 lbs.**
 - 30% average weight = 52 lbs.
 - 40% average weight = 70 lbs.
 - 45% average weight = 78 lbs.
- **Note: 11B soldiers tend to weigh slightly less than overall soldier population, but are better physically conditioned.**
- **Demographic trends predict slight weight reductions in Army population through 2010**



- If 40% Body Weight Is Boundary Condition:
 - Target “Optimal” Load Weight = 70 lbs.

But...as a Design Criteria, This Weight Would Be Too Heavy for 50% of the Army Population

- If Choose 5th Percentile for Target Load....
 - 40% of 136 lbs. = 54 lbs.

➡ 95% of the Infantry Would Carry Loads Less Than or Equal to the Boundary Condition



Many Factors Influence Soldier Load Carriage Capability

- **Soldier Height, Weight, Conditioning**
- **Load Mass**
- **Speed of March**
- **Type of Terrain**
- **Distribution of the Load**
- **Volume of the Load**

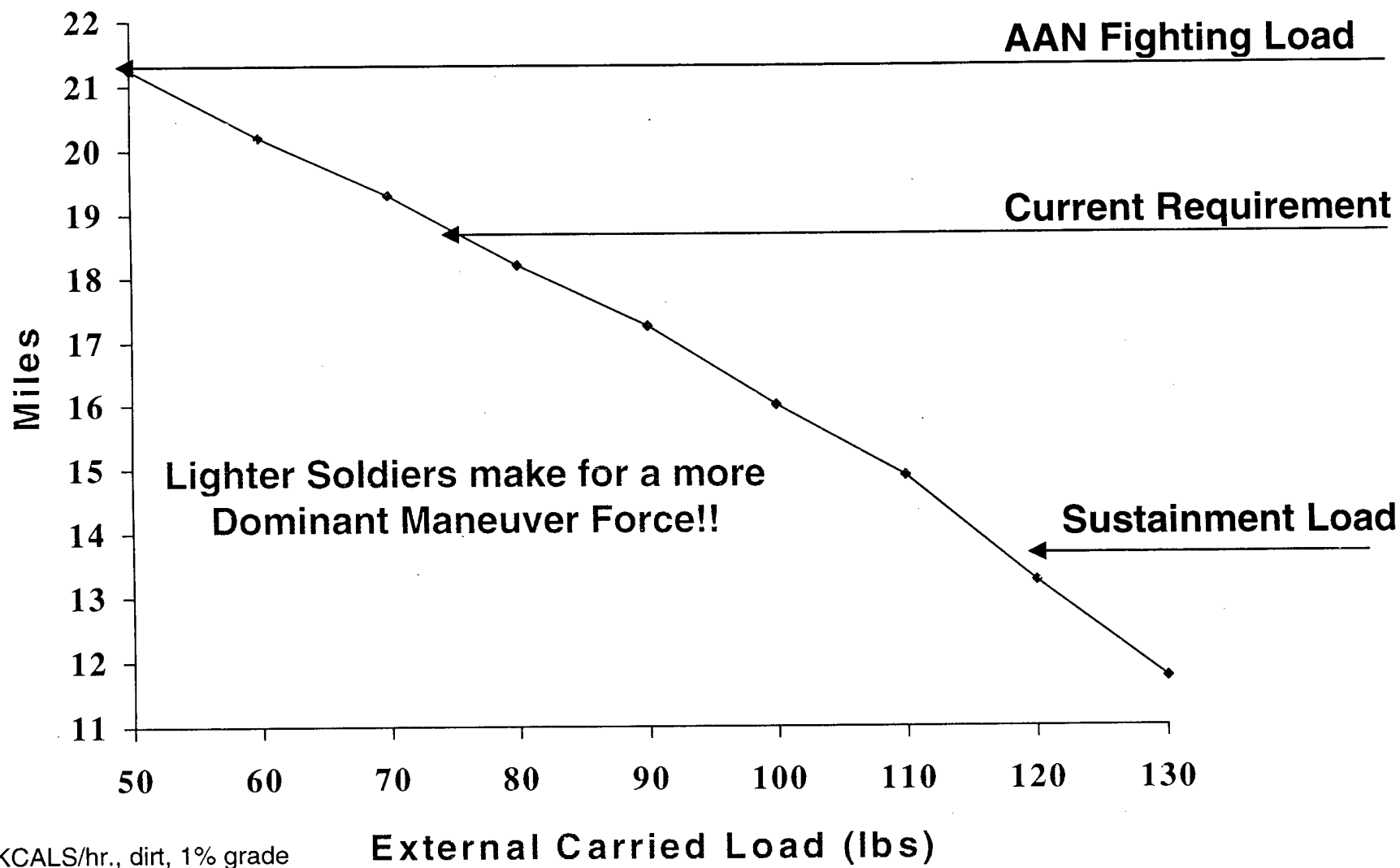


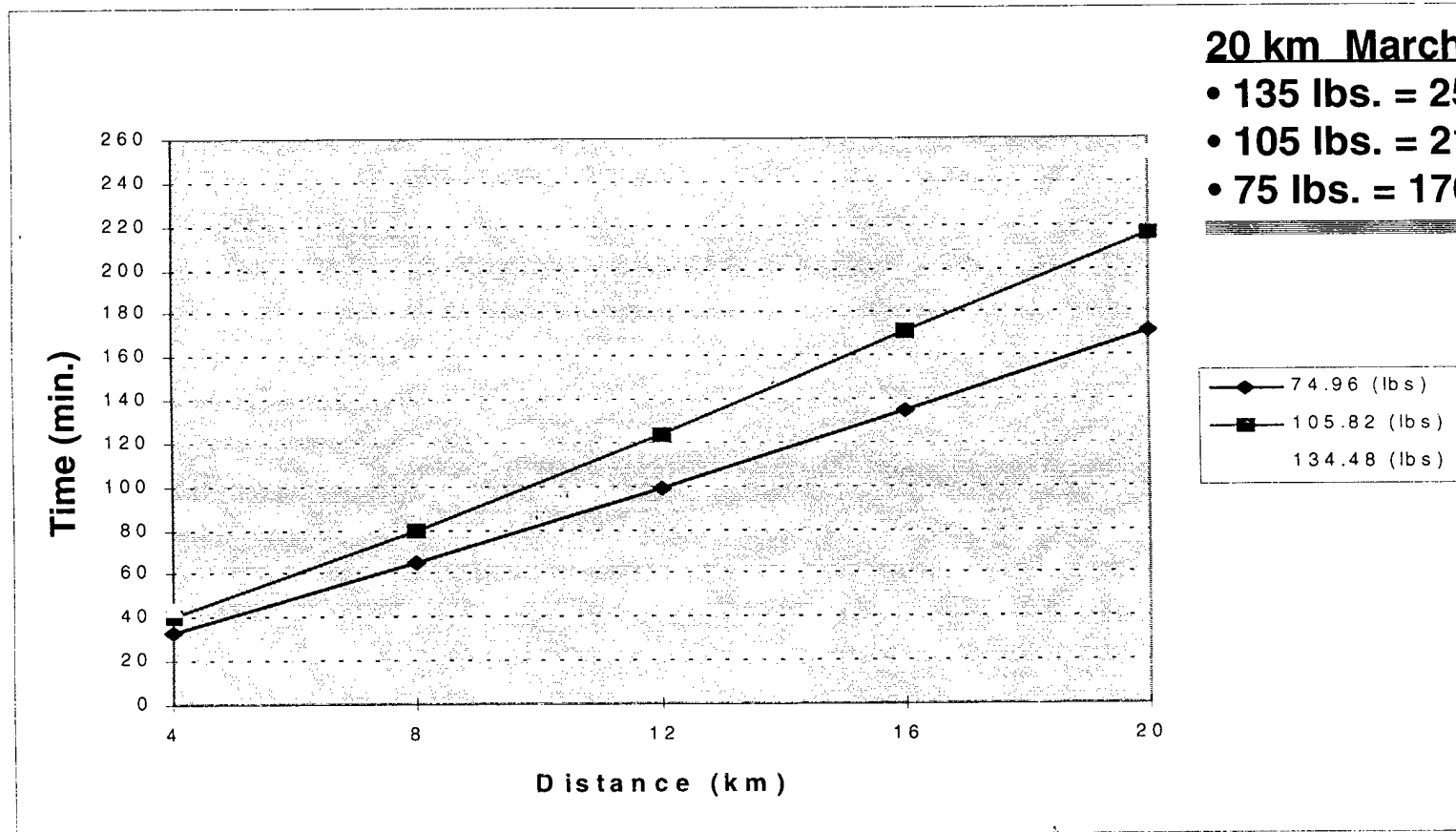
TR 97-023, DBS 97-031, 97-032, IN 97-310, 97-320

- **Decrease the soldier's load while increasing capability.**
- ***Payoff =***
 - **Increase mobility and survivability of soldiers.**

TR 97-044, DBS 97-020, AV 97-007

- **Lightweight environmental and ballistic protection.**
- ***Payoff =***
 - **Enhanced soldier survivability and mobility.**
 - **Allow soldiers to operate in all environments with less bulk and heat stress.**





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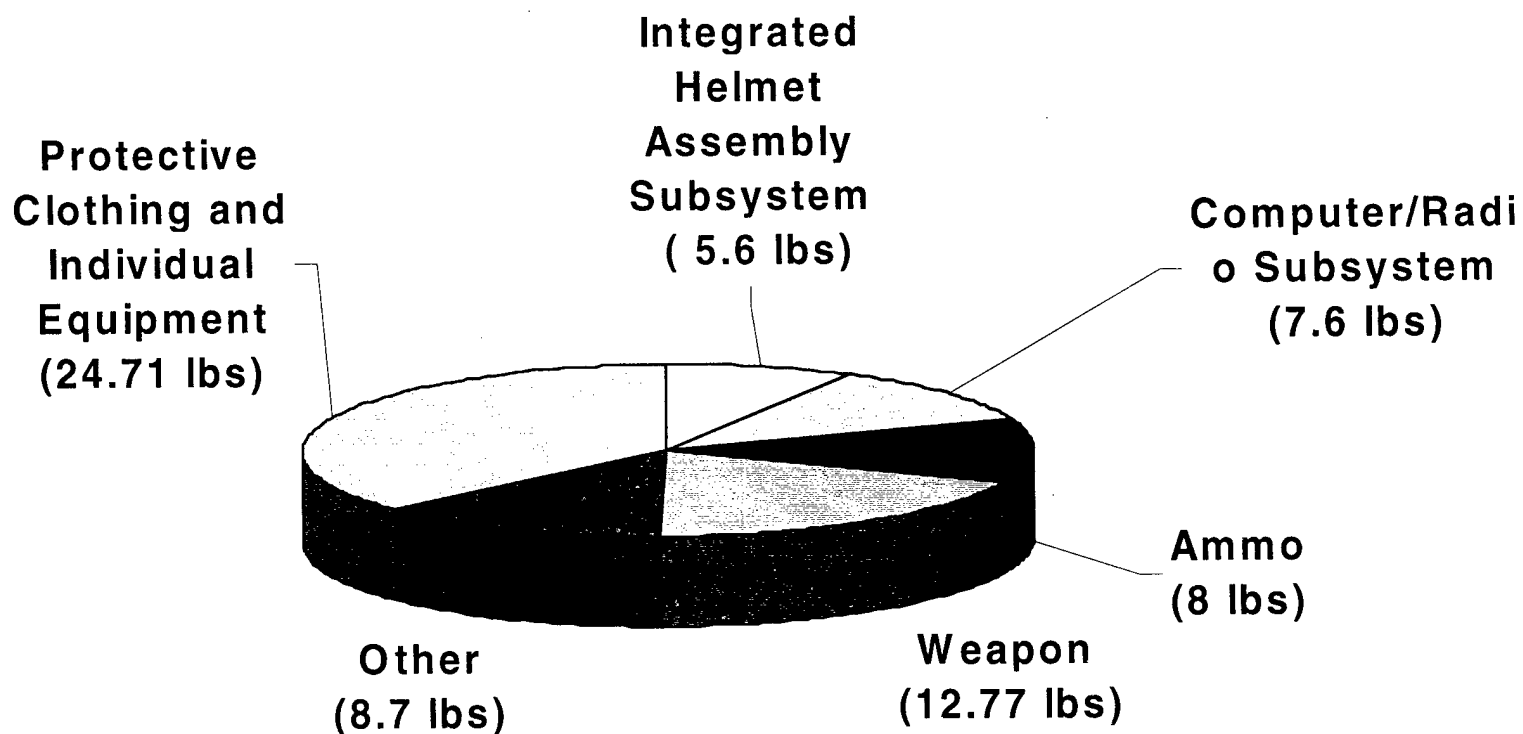


		Load	Kilocalories Expended Per Hour											
Footing Factor	March Rate	(lbs)												
1.2	(km/hour)	0	10	20	30	40	50	60	70	80	90	100	110	120
Light Brush	1.6	116	118	121	125	131	139	149	160	174	190	209	231	256
	2.4	144	148	153	159	167	176	187	201	216	234	255	278	305
Grade	3.2	183	190	197	205	216	227	241	257	275	296	319	345	374
0	4	234	243	254	265	279	294	311	330	351	375	401	430	462
	4.8	296	309	323	339	356	375	396	418	443	471	501	534	570
	5.6	369	386	405	425	447	471	496	523	553	585	620	657	698

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		Load	Kilocalories Expended Per Hour											
Footing Factor	March Rate	(lbs)												
1.2	(km/hour)	0	10	20	30	40	50	60	70	80	90	100	110	120
Light Brush	1.6	175	180	187	195	205	216	229	244	262	282	305	330	358
----	2.4	232	241	252	263	276	291	308	327	348	372	398	427	459
Grade	3.2	301	314	329	345	362	381	402	425	451	479	509	542	579
5	4	380	399	418	439	462	486	512	540	571	603	639	677	718
	4.8	471	496	521	547	576	605	637	671	707	746	787	831	878
	5.6	574	604	636	669	703	740	778	818	861	905	953	1003	1057



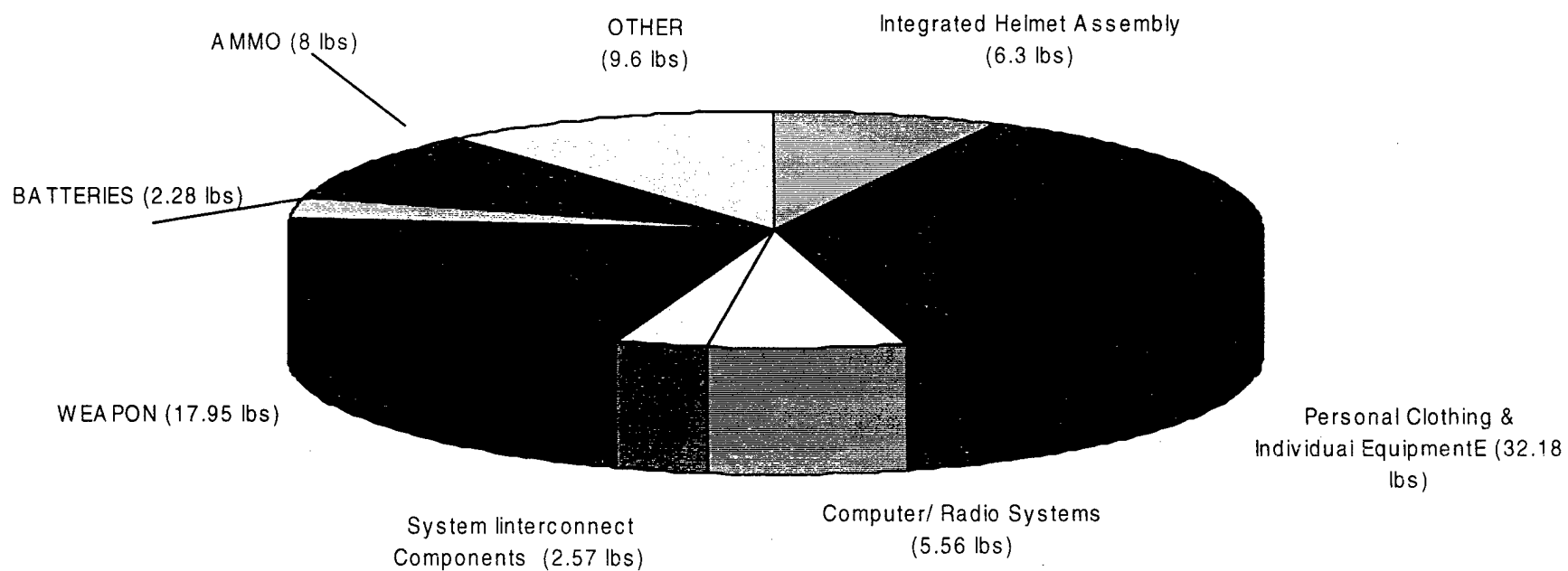
TOTAL WEIGHT: 67.4 lbs



<u>ITEMS</u>	<u>WEIGHT (lbs)</u>
M16A4 RIFLE W/ M5 AR/ SLING	10.4
PASGT VEST	6.8
6X30 ROUND MAGAZINES, 5.56	6
WATER, 1QT.	4.2
BOOT, COMBAT	4.1
GPS/ SLUGR	4
PRC 126 W/ EXTRA BATT.	3.6
HELMET, BALLISTIC, (MED)	3.4
BINOCULARS, 7X35	3.2
PROTECTIVE MASK W/DECON KIT	3

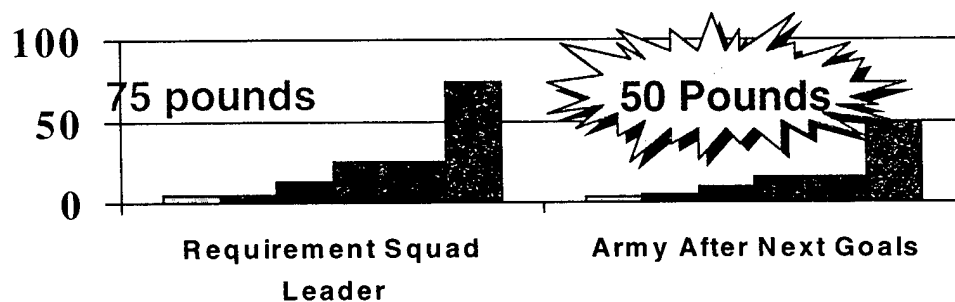


TOTAL WEIGHT: 84.4 LBS

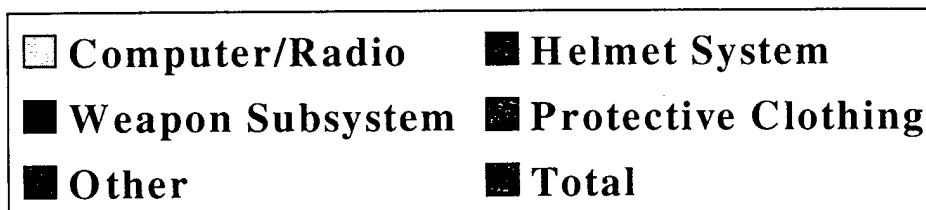




<u>ITEMS</u>	<u>WEIGHT (lbs)</u>
MODULAR WEAPON SYSTEM	8.4
BODY ARMOR	7.7
LCE FRAME W/ VEST PANELS	6.8
6X30 ROUND MAGAZINES, 5.56	6
THERMAL WEAPON SIGHT (TWS), HEAVY,	4.95
INTEGRATED HELMET ASSEMBLY	4.4
WATER, 1QT.	4.2
BOOT, COMBAT	4.1
M45 NBS MASK	3.9
BINOCULARS, 7X35	3.2

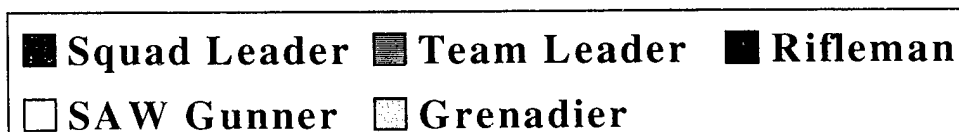
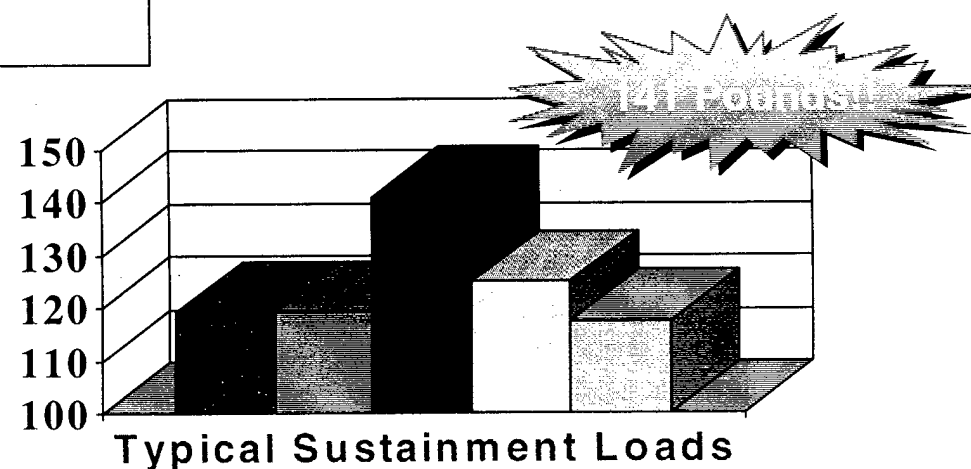


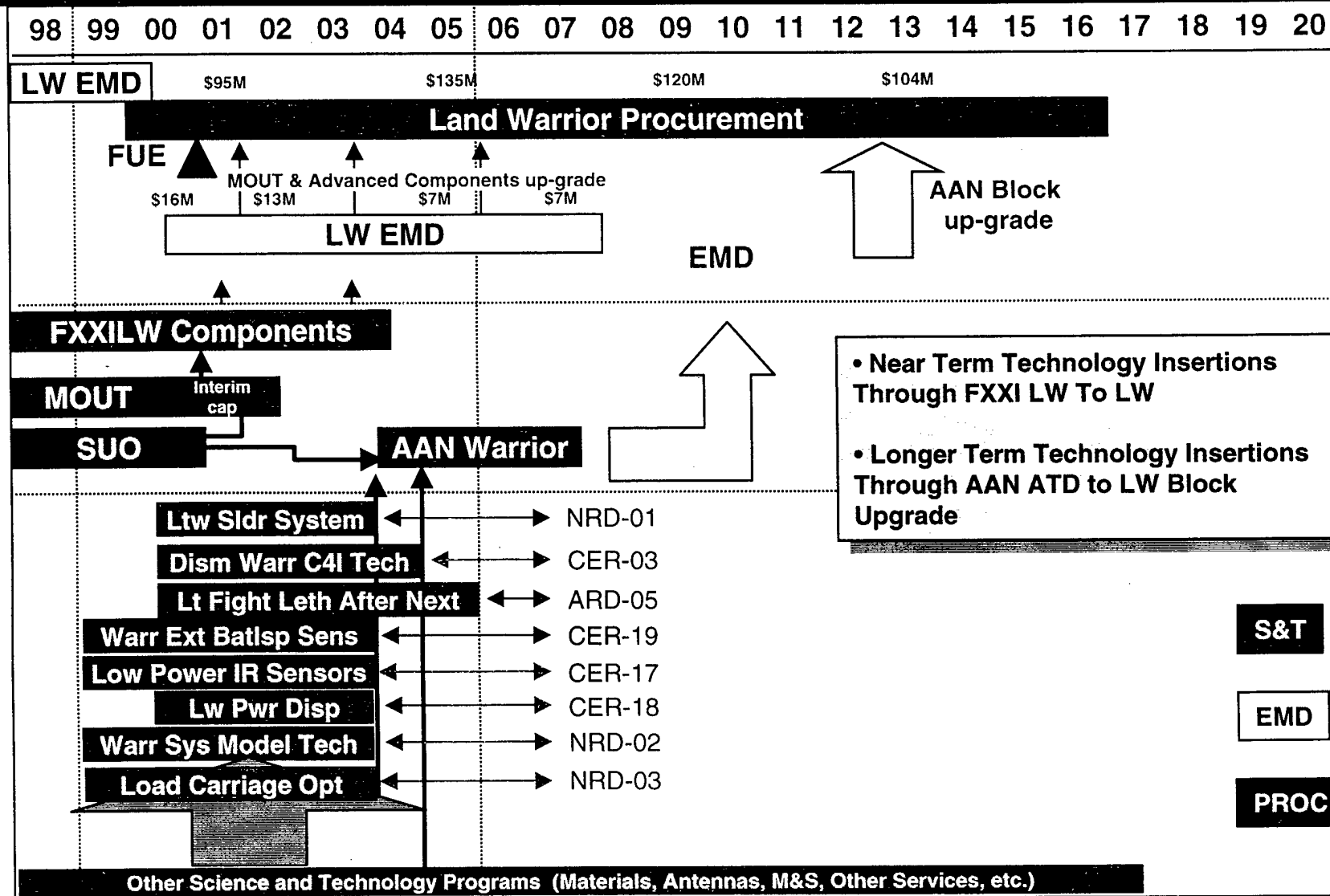
Wide Margin for Improvement for AAN



Requires Complete Systems Approach

Weight (lbs)







Define The Future Dismounted Warrior System Architecture

- **Reduce Weight**
 - Increase Tactical Mobility
 - Reduce Workload & Fatigue
 - Goal: 50 Pound Fighting Load
- **Reduce Power/Energy**
 - Reduce Weight, Volume, Life Cycle Cost
 - Goal: 50% of Land Warrior Battery Requirement
- **Reduce Cost**
 - Increase Rate of Deployment, Force Coverage
 - Goal: 35% Reduction in LW/FXXI LW DTUPC
- **Improve Fightability**
 - Increase Combat Effectiveness





- **Urgency of the Problem Still Exists - Loads Are Still Too Heavy**
- **Maximum Loads Must Be Matched With Human Physiological Capabilities**
 - **Weight Constraints Must Be Instilled As System Design Criteria**
 - **Technology Must Not Be Introduced Until Weight Constraint Is Met**
- **If We Care Enough for Our Soldiers ...**
 - **Technology Will Be Forced to Achieve Load Reductions**
 - **Commanders Will Enforce Specific Weight Constraints.**